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(54) Title: BUS ARRIVAL NOTIFICATION SYSTEM AND METHODS RELATED THERETO

(57) Abstract: The present invention relates to a system and methods for notifying passenger of an approaching vehicle. Utilizing this invention, passengers can remain in a safe, controlled environment, avoiding harsh environmental conditions and excessive waiting times, instead arriving at their pick-up point just prior to a vehicle's arrival. More specifically, the present invention relates to a bus notification system wherein passengers are able to know the precise location and arrival time of the transporting vehicle several minutes before its arrival at a specified location along the vehicle route.

BUS ARRIVAL NOTIFICATION SYSTEM AND METHODS RELATED
THERE TO

5

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a system and methods for notifying passengers
10 of an approaching vehicle. Utilizing this invention, passengers can remain in a safe,
controlled environment, avoiding harsh environmental conditions and excessive
waiting times, instead arriving at their pick-up point just prior to a vehicle's arrival.
More specifically, the present invention relates to a bus notification system that will
provide a passenger with adequate warning of an approaching bus well in advance of
15 its arrival at the bus stop.

Background Art

In many cities and towns, school systems are required to provide
transportation to and from school for children living more than a specified distance
20 from school. Generally this transportation is in the form of busing whereby school
buses pick up school children at several bus stops along several bus routes and then
deliver the children to their school. The arrival time of a school bus at a given bus
stop can vary significantly from day to day for any of a number of reasons. As a
result, children typically arrive at the bus stop well before the bus is expected to arrive
25 to avoid missing the bus. These children frequently lack parental supervision.
Furthermore, on inclement weather days, children waiting for their bus are exposed to
harsh weather conditions including rain, snow, or extreme cold. To avoid this
situation, concerned parents frequently wait with their children at the bus stop in a car,
causing unnecessary pollution.

30

Buses can be delayed for numerous reasons including inclement weather, such
as fog, snow, ice or extreme cold, which reduces the speed of the bus and thus
impedes the arrival of the bus at the planned time. Similarly, bus mechanical
problems, heavy traffic or substitute bus drivers can generate lengthy delays in bus

arrival time. In addition, many school buses will make several sequential runs to pickup children for different schools such as the high, middle and grade schools for a town. A delay in picking up children in the first run can result in similar or longer delays for subsequent runs. Correspondingly, it is possible, when there is good
5 weather and light traffic conditions, for the bus to arrive at the bus stop earlier than the planned time.

In areas where bus routes cover many miles there frequently is a large variance in arrival time of a bus at the bus stops along the route and in many instances
10 the bus stop will not be visible from the home. Similarly in areas where children live closer together, frequently there are communal bus stops for several children such that the bus stop is not visible from the home of each child. Advance notification of bus arrival also allows time to prepare the children for school without rushing to catch the bus.

15

There are many other situations where passengers and their families might find advance bus notification information useful. Children with special needs will especially benefit from such information, as they will have adequate warning time by which to prepare for boarding of the bus. Additionally, all passengers will be relieved
20 of the shock factor of a bus pulling up unannounced.

There is disclosed in U.S. Patent 4,325,057 a bus notification system wherein each bus transmitter emits a signal at a unique radio frequency to identify a specific bus. Each receiver is then tuned to the frequency corresponding to said bus
25 transmitter and the length of time between notification and bus arrival is determined by adjusting the receiver's sensitivity control. When the receiver acquires the bus transmission above the predetermined sensitivity threshold the notification system is activated.

30 Similarly, there is disclosed in U.S. Patent 5,144,301 an alert system using different radio frequencies to identify particular buses and receivers that are tuned to the appropriate radio frequency wherein the time to bus arrival is approximated by comparing the received signal strength to an adjustable threshold setting. When the

received signal strength exceeds the threshold, the receiver sequentially activates visual and audio warning signals.

In U.S. Patent 5,021,780, there is disclosed an arrival notification where each bus emits an encoded signal uniquely identifying the bus and receivers in homes
5 along the route are adjusted prior to distribution to receive only the encoded signal transmitted by the bus. The alerting mechanism in the receiver is activated upon detection of the encoded bus transmission using signal strength to estimate arrival time. However, the receiver does not incorporate a method for adjusting the alerting mechanism sensitivity. As a result, there is no available means to control the delay
10 time between notification and bus arrival. Additionally, since the receivers in homes are adjusted prior to distribution, any bus changes or household moves to new buses introduces additional logistics problems.

In these disclosures, the time to bus arrival is approximated by the strength of
15 the bus transmission signal received at the household. Signal strength, however, may not be an accurate measure of distance in every case because obstructions in the wireless radio frequency path can further reduce the signal strength thereby tricking the distance calculation by the receiver. The reduced signal strength can significantly reduce the time period between notification of bus arrival and the actual arrival of said
20 bus. In addition, if the bus route includes several streets that are in close proximity requiring the bus to double back to cover said streets; the possibility for premature notification arises. Further, if two adjacent school districts use the same radio frequency, false alarms and premature notifications can result from two buses in neighboring districts broadcasting the same radio frequency.

25

A complex advance notification system for alerting passengers when a vehicle is ahead of or behind schedule is disclosed in U.S. Patent 5,400,020. In this system, a vehicle control unit compares the actual time at which the vehicle reaches a predetermined location along the vehicle route against the scheduled arrival time,
30 where the vehicle location is determined by global positioning system (GPS) technology. If there is a discrepancy between the actual and scheduled time values, the vehicle control unit relays the time discrepancy to a base station control unit by wireless communication. The base station control unit notifies each passenger of the change in arrival time by telephone. Thus, arrival time notification only occurs if the

vehicle is off schedule. Further, the notification system requires that the telephone line be open and a person present to receive the telephone call. If the passenger is unable to hear the telephone ring such as when the phone is already in use or when the passenger is outside awaiting the arrival of the vehicle, the notification system will
5 fail.

Another complex system for notifying passengers waiting for public transit vehicles of the status of transit vehicles, including expected arrival times of vehicles at transit stops and arrival of connecting transit vehicles is disclosed in U.S. Patent
10 6,006,159. The disclosed system determines the location of transit vehicles by using a GPS device. The vehicle location is transmitted to a central facility wherein the central processor generates a master transit table for all vehicles calculating scheduled stops, connections to other transit vehicles and arrival times at each scheduled stop. The master transit table is subsequently broadcast to display devices located
15 throughout the geographic area of the transit system including display devices in vehicles and transit stops. The display device stores the transit table or a subset thereof and displays selected information. In addition, the transit table or a subset thereof can be received by portable display means such as pagers, computers or telephones.

20

This transit notification system is appropriate for city or regional public transportation systems where the system involves a large number of passengers who are traveling between any two transit stops within the transit system and a large number of transit vehicles which are traveling on numerous transit routes within a
25 large geographic area. The central facility must have sufficient resources to process a continuous data feed from each vehicle in the system to form updated transit tables and broadcast the transit table over the entire geographic area of the transit system. This system of notification requires a significant investment of resources in infrastructure development including installation of the central processing center,
30 smart display devices throughout the transit system and vehicle information units in the transit vehicles.

Many passengers predominantly use a transit system to travel between two points such as a commute between home and work. The portable display devices

disclosed in this patent are capable of displaying arrival information for a vehicle at a selected vehicle stop, but they can not alert a passenger that a vehicle will arrive at said vehicle stop within a predetermined period of time. Frequently, an automated notification process is desirable to alert the passenger that it is time to start the
5 commute. A device capable of alerting such a commuter of the exact time by which to leave for their commute prior to leaving their controlled environment would be ideal.

In U.S. Patent 5,680,119, there is described a vehicle identification system
10 wherein types of vehicles such as emergency, school bus or other public transportation, delivery or service vehicles with emitters transmit an identifiable signal corresponding to the vehicle type. This patent does not describe a method for identifying a unique vehicle of a particular class, but rather only a method for determining the type of vehicle. Thus, the system merely differentiates between a
15 school bus and an ambulance.

A receiving unit acquiring a RF signal broadcast from a nearby vehicle containing the correct information that is not actually picking up passengers can incorrectly notify passengers of a vehicle arrival at a specified point along the vehicle
20 route. For example, one common passenger pickup technique is to drive all the way to the end of a vehicle route and then commence picking up passengers from the end of the route. This pickup technique poses problems for passengers near the beginning of the route, who are passed by the vehicle traveling in the wrong direction a considerable time before their vehicle actually stops to pick them up. In another
25 example, public transportation vehicles frequently stop at each station in both directions along the vehicle route. Incorporation of a direction of travel parameter into the information transmitted from a vehicle would be especially valuable, allowing a receiving unit to only activate an alert mechanism when receiving a transmission from the correct vehicle traveling in a specified direction.

30

It thus would be desirable to provide a notification system that can more accurately predict a precise time of vehicle arrival such that a passenger's waiting time for the vehicle is minimized. Such a notification system also should be less complex, less costly and not require extensive infrastructure as compared to prior art

systems. Additionally, such systems and particularly the receivers therefor should be inexpensive and not require highly trained individuals to operate the equipment.

SUMMARY OF THE INVENTION

5 The present invention features a vehicle arrival notification system that will enable passengers to know the precise location and arrival time of the transporting vehicle several minutes before its arrival. The notification system comprises a transmission apparatus on a vehicle and receiving units at various locations along the vehicle route such as businesses, households, schools and the like. The transmission
10 apparatus includes subsystems for determining the exact location of the bus and transmitting a signal including information identifying the vehicle route and the current vehicle location. The receiving unit compares the current vehicle location and direction of travel with information stored in its vehicle arrival log, thereby determining the time until the arrival of the vehicle at the specified location along the
15 vehicle route. The alert function, either audio or visual, is activated when the receiving unit determined vehicle arrival time is less than an adjustable time threshold set by the passenger. The alarm function can also work off of a distance threshold, wherein the passenger sets an adjustable distance trigger to activate the alarm, the receiving unit determines the distance between the vehicle and the receiving unit with
20 a simple distance calculation and the alarm is triggered when the calculated distance is less than the threshold.

 In a preferred application of such a notification system, children and their parents are alerted to the approach of a school bus to pick up the children at a school
25 bus stop. The accurate notification of an approaching school bus can minimize if not significantly eliminate the children's wait at the bus stop and consequently their exposure to inclement weather. Children can spend a few extra minutes inside their home with their parents instead of enduring lengthy waits at the bus stop in potentially adverse conditions. In addition to notifying households of an approaching bus
30 picking children up to go to school, the receiver will also alert parents of an approaching school bus dropping children off at the end of the school day.

 The system includes the means to accurately determine the location of the vehicle and the location of any specified vehicle stop so that the distance between the

vehicle and the vehicle stop and the corresponding time can be accurately measured. Global positioning satellite (GPS) technology generates extremely accurate location coordinates by analysis of signals from a plurality of global positioning satellites. Receiving units within the range of the transmission apparatus' RF signal receive the

5 GPS determined location of the vehicle regardless of the strength of the RF signal and calculate the distance between the vehicle and the vehicle stop using GPS determined locations for both the vehicle and the vehicle stop. Unlike systems relying on signal strength to determine the distance that are subject to inaccuracies resulting from obstructions in the wireless radio frequency path, the vehicle location as determined

10 by GPS is independent of signal strength. As a result, a receiving unit can accurately calculate an associated arrival time and the distance between receiving unit and vehicle, thereby providing accurate arrival information.

In specific embodiments, the system further includes the means to determine if

15 an approaching vehicle is traveling in a specified direction so that passengers are only notified when a vehicle is approaching a vehicle stop from a specified direction. The transmission apparatus further includes the means to determine the direction of vehicle travel by GPS technology and transmit a signal further including information about the direction of vehicle travel. Each receiving unit further compares the

20 received direction of vehicle travel with a specified direction of vehicle travel such that an alarm function is activated when the vehicle is closer than a specified threshold location and traveling in the specified direction.

In preferred embodiments of the invention, the receiving unit further includes

25 the means to acquire information about a vehicle by a simple information acquisition protocol herein referred to as the learn function. Activating the learn function when a vehicle approaches the vehicle stop causes the receiving unit to acquire the vehicle route number and direction of vehicle travel from the vehicle transmission unit signal. The receiving unit location coordinates are also acquired by the receiving unit from

30 the bus transmission unit signal. After the learn function has been activated, the receiver listens for the transmission signal of greatest amplitude. When signal amplitude is maximized and distance between the transmitter and receiver is minimized, the bus stop location is stored into the receiver memory. Alternatively,

the bus stop location can be simply stored into the receiver memory when the learn button is depressed.

Additional information is also transmitted from the transmitter to the receiver
5 at this time. More specifically, a historical log file that includes vehicle location and direction of travel for at least one time entry is stored into the receiver's memory so that this data can be later accessed to understand exactly how the bus approached the bus stop. Preferably, the historical log file includes at least five minutes of time
10 entries wherein sequential time entries are separated by a small time increment such as 10-30 seconds. As a result, the vehicle information acquired by the receiving unit during the learn function is used by the notification system to determine when to alert passengers that their specific vehicle is approaching.

In another embodiment of the present invention, the transmission apparatus
15 further includes the means to electronically store information about the vehicle during operation. A vehicle log file is generated including an entry for each transmitted RF signal such that each entry includes a time mark and the transmitted vehicle location coordinates. Each vehicle log file entry can further include additional information such as vehicle speed and/or direction of vehicle travel. Information stored in a
20 vehicle log file can be downloaded to a PC for use in monitoring vehicle operation. The information contained in the vehicle log files can be used to monitor vehicle operator performance and to determine the validity of passenger complaints regarding vehicle operation.

25 In a preferred embodiment of the present invention, the system includes a transmission apparatus that can be programmed with new vehicle information and to download information stored in a vehicle log file. A transmitter pendant interfaces with a transmission apparatus such that the pendant can display current transmission apparatus information and introduce new information. The transmitter pendant can
30 further include an apparatus to download information stored in the vehicle log file of the transmission apparatus and transfer this information to a PC.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and desired objects of the present invention, reference is made to the following detailed description taken in conjunction with the accompanying drawing figures wherein like reference character denote corresponding parts throughout the several views and wherein:

5 Fig. 1 is a schematic diagram of the notification system, 100, that includes a transmission apparatus 160 and at least one receiving unit 120.

 Fig. 2 is a block diagram of a receiving unit 120 components.

 Fig. 3 is a block diagram of the transmitter apparatus 160 components.

 Fig. 4 is an example of a historical log file stored in receiving unit memory
10 and the receiving unit protocol for determining when to activate the alarm.

 Fig. 5 is a schematic diagram of a transmitter pendant 200.

 Fig 6 is an example of a vehicle track plot where the vehicle route is indicated by circles and vehicle speed indicated by the circle shading.

15 DETAILED DESCRIPTION OF THE INVENTION

 Turning now to the drawings, where like components are designated by the like reference numerals, FIG. 1 schematically illustrates one preferred embodiment 100 of a vehicle arrival notification system in accordance with the present invention. Here, a transmission apparatus 160 is located in a vehicle and receiving units 120 are
20 located along the vehicle route in, for example, households and schools, to alert of an approaching vehicle in advance of its arrival at a specified point on the vehicle route.

 The transmission apparatus 160 determines the vehicle location and transmits a RF signal that includes vehicle identification and location information. Referring
25 now to Fig 3, and as indicated elsewhere herein, the transmission apparatus 160 has located therein a global positioning system (GPS) device 170 that receives signals from a plurality of global positioning satellites through a GPS antenna 164 and can determine vehicle location at any time from the received satellite information. Information about vehicle location is communicated to the transmission apparatus
30 central processing unit (CPU) 162 from the GPS device 170.

 The transmission apparatus CPU 162 preferably has the ability to execute and control transmission apparatus protocols and tasks. The CPU receives vehicle location information from the GPS device 170 and vehicle identification information

from transmission apparatus memory means 174 and generates a signal that includes vehicle identification information and vehicle location.

The transmission apparatus 160 preferably further includes a transmission
5 module 166 that generates a RF signal from the signal created by the microprocessor. The transmission module broadcasts the RF signal from RF antenna 168 over at least one radio frequency. Preferably, the RF signal is transmitted over a plurality of radio frequencies using channel hopping technology such that the transmission apparatus achieves maximal signal transmission range. The transmission apparatus CPU 162
10 has the means to monitor transmission module activity such that if the transmission module 166 fails to broadcast a RF signal, then the CPU activates a transmitter malfunction warning light 176.

The transmission module 166 processes the transmission signal generated by
15 the CPU and transmits a RF signal. Preferably, Spread Spectrum technology with channel hopping is used to transmit the RF signal. As is well known in the art channel hopping maximizes effective signal range by providing maximal power while adhering to FCC Part 15 specifications. Preferably the number of channels used in channel hopping signal transmission is at least 25. More preferably the number of
20 channels used in channel hopping signal transmission is at least 50. Complying with FCC Part 15 specifications, preferable transmissions are at 1 watt time intervals not to occupy a channel in excess of 0.4 seconds within a 10 second period. Additionally, bandwidth is minimized to maximize range wherein the frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or
25 the 20 dB bandwidth of the hopping channel, whichever is greater. A transmission apparatus will transmit vehicle information in packets of between 32 and 256 bits including vehicle identification information, vehicle location coordinates and when directional shielding is employed, direction of vehicle travel. The data transmission rate is at least 100 bps to generate a short transmission cycle. Preferably, the data
30 transmission rate is at least 300 bps. For example, at 300 bps: 50 channels x 32 bits/300 bps = 5.3 seconds with a 5 to 10 second delay results in a 10-15 second transmission cycle.

The transmission apparatus 160 also includes a memory system 174 wherein vehicle identification information including, but not limited to vehicle route number and district information are stored electronically. The transmission apparatus memory means 174 can further store a vehicle log file wherein the log file includes a plurality
5 of time-marked entries. The transmission apparatus CPU 162 has the means to generate log file entries such that each entry includes a time stamp recorded from a transmission apparatus clock and GPS determined vehicle location coordinates. Additional data parameters such as the direction of vehicle travel and vehicle speed can also be incorporated into a vehicle log file as necessary for specific applications.
10 The transmission apparatus CPU 162 generates log entries on a conveniently short time-interval such as the periodicity of transmission apparatus RF signal broadcast.

In a preferred embodiment, the RF signal broadcast by the vehicle transmission apparatus 160 includes vehicle identification information and a historical
15 log. The transmission apparatus CPU 162 includes the means to access the vehicle log file stored in the transmission apparatus memory means 174 and to generate from the vehicle log file a historical log file including at least 5 minutes of the most recent vehicle log file time entries. Preferably the historical log file includes at least 10 minutes of the most recent vehicle log file time entries. The transmission apparatus
20 160 as above described broadcasts a RF signal comprising vehicle identification information and the historical log file generated by the transmission apparatus CPU.

Now referring to Fig 2, and as indicated elsewhere herein, receiving units 120 located along a vehicle route receive signals from at least one vehicle transmission
25 apparatus within broadcast range and alert passengers when the correct vehicle is closer than a specified threshold location or distance. The receiving unit 120 includes a receiving module 138 and a RF antenna 136 such that the receiving module channel hops intelligently to receive RF signals broadcast by nearby vehicle transmission apparatus 160.

30 The receiving unit 120 further includes a CPU 122 wherein the CPU is in communication with the receiving module 138 such that the CPU receives RF signals from the receiving module. The receiving unit CPU 122 has the means to determine vehicle identification information and vehicle location from a received RF signal. Further, the CPU has the means to compare vehicle identification information

included in the RF signal to identification information for the correct vehicle stored in receiving unit memory 126. The receiving unit CPU 122 further has the means to compare transmitted location information for the correct vehicle with its stored historical log files to determine the appropriate vehicle location by which to activate
5 an audio or visual alert mechanism such as an audio speaker 150 and give the user adequate time by which to meet the vehicle at the bus stop. Alternatively, the receiving unit 120 has the means to identify the RF signal for the correct vehicle, calculate the distance between the GPS determined locations of the correct vehicle and the receiving unit such that the receiving unit CPU compares the calculated
10 distance with a specified threshold distance and activates an audio or visual alert mechanism such as an audio speaker 150 when the calculated distance is less than the threshold distance.

The receiving unit 120 includes a vehicle display 140 for displaying of the
15 calculated distance between the receiving unit and the correct vehicle or the calculated time to vehicle arrival wherein the distance or time is displayed in a convenient unit of measure such as miles or minutes respectfully. Additionally, the threshold distance or arrival time threshold can be adjusted by a threshold control mechanism 148 wherein non-limiting examples of threshold adjustment mechanisms are a switch,
20 button or dial. The specified threshold entered using the threshold control mechanism 148 is displayed in a threshold display 144 wherein an arrival time threshold is displayed in minutes and a distance threshold is displayed in miles. In the normal run mode, when the threshold adjustment is not being adjusted, calculated bus distance and an estimated time to arrival are both displayed.

25 The receiving unit 120 includes a memory means 126 wherein are stored the GPS determined receiving unit location, specified threshold time or distance, a historical log file and vehicle identification information for the vehicle for whose arrival passengers are to be notified. Preferably the receiving unit memory means 126
30 is an inexpensive memory storage device that can be manufactured with a limited service life. More preferably the receiving unit memory means 126 is a Smart Card with a one year renewable service life such that consumers are required to resubscribe to maintain receiving unit operation.

The receiving unit 120 also includes a learn function wherein the learn function includes the means for acquiring information about a specified vehicle. Actuating the learn button or switch 124 when the correct vehicle is approaching a specified vehicle stop causes the receiving unit CPU 122 to acquire vehicle
5 identification information from the strongest received RF signal and to store this vehicle identification information in the receiving unit memory means. The receiving unit CPU further includes the means to monitor the vehicle location in the learn function whereby the GPS determined vehicle location is stored in the receiving unit memory means as signal amplitude is maximized and distance between the transmitter
10 and receiver is minimized.

In an alternate methodology, the receiving unit 120 learn acquires the receiving unit location coordinates, bus route number and direction of bus travel from the bus transmitter signal. As the bus approaches the bus stop on the first day of
15 school, a parent or child waiting at the bus stop activates the receiving unit 120 learn function. The receiver captures the bus route number the direction of travel from the bus transmitter signal. Deactivating the learn function button after the bus has stopped at the bus stop captures the bus location coordinates whereby the bus location coordinates are stored in receiving unit memory 126 as the receiving unit location.

20

In a specific embodiment of the present invention, the system 100 further provides a directional shield to increase the notification accuracy for vehicle arrival. The vehicle transmission apparatus GPS device 170 further includes the means to determine the direction of vehicle travel. The transmission apparatus CPU 162
25 further incorporates the direction of travel into the RF signal broadcast by the transmission apparatus 160 whereby a receiving unit 120 further compares the received direction of vehicle travel against a specified direction of vehicle travel stored in the receiving unit memory means 126 during activation of the learn function. Preferably, the direction of vehicle travel is expressed in degrees, the standard NMEA
30 directional output from the GPS device 170. However, any other method for reporting the direction of vehicle travel is also acceptable. The activation of an alert mechanism by a receiving unit 120 is additionally dependent upon the received direction of vehicle travel being coincident with the stored direction of vehicle travel. By incorporating a direction of travel parameter into the information included in the

transmitted RF signal from a bus, the receiving unit alert mechanism is triggered only when receiving a transmission from a bus with the correct bus route number traveling in the correct direction located within a specified distance threshold.

5 Referring now to FIG. 2, and as indicated elsewhere herein, the system can further include a transmission pendant 200 wherein the transmission pendant 200 connects to a transmission apparatus download port 180 via an interface 204. The transmission pendant 200 includes a display 208 whereby current vehicle
10 identification information stored in the transmitter apparatus memory means is viewable. The pendant 200 further includes the means to change or modify vehicle identification information that is transmitted from a particular transmission apparatus 160. Additionally, the pendant 200 contains a memory means for electronically
15 storing the contents of at least one transmission apparatus vehicle log file and the means to download the contents of a vehicle log file from a transmission apparatus 160. Further the transmission pendant 200 will include a standardized PC connection such as an RS-232 connection for transferring downloaded transmission apparatus
20 data to a PC. There are sufficient adjustment controls 212 to efficiently enter vehicle identification information modifications and to effect download of vehicle log file . . . data from the transmission apparatus to the connected pendant.

20

 While a pendant 200 is disclosed as the preferred embodiment, others comparable transmission apparatus 160 not requiring a pendant 200 could be easily constructed. For instance, route information adjustments could be mounted directly to the transmission apparatus 160. Utilizing the transmitter's transmission capabilities,
25 bus information could be uploaded directly to a PC wirelessly, eliminating the need for a pendant 200.

 In a preferred embodiment, a pendant 200 is utilized to minimize costs by eliminating many of the transmission apparatus adjustments and displays. The transmission pendant 200 can be any device that can interface with bus transmission
30 apparatus 160, has an input device 212 to modify the bus transmission apparatus parameters or execute a bus log file capture, and has an interface 204 capable of connecting to a PC to facilitate data transfer. Preferably the transmission pendant 200 is a modified hand-held electronic personal organizer, such as a Palm Pilot, with the necessary interface ports and software to comply with the above stated requirements.

Now referring to FIG 6, and as indicated elsewhere herein, in a specific embodiment of the present invention, vehicle log files downloaded from the vehicle transmission apparatus to a PC include data on where the corresponding vehicle has
5 been and the speed of the vehicle along its route. The PC includes the means to process the information included in a vehicle log file to generate a corresponding vehicle track plot wherein the location and speed of the bus at each vehicle log file entry is transferred to a map or graphical representation of the vehicle route. A symbol or alphanumerical character marks vehicle location. Vehicle speed is
10 expressed graphically according to a specified legend by either coloring, shading or otherwise marking the location symbols or alphanumerical characters with the appropriate marking from the speed legend. A circle graphically represents the vehicle location for each vehicle log file entry and vehicle speed is represented by grayscale shading the corresponding location circle according to the "Speed in m.p.h."
15 legend. Alternatively, several vehicles can be displayed in one vehicle track plot whereby each vehicle is identified by different marker morphologies.

In another specific embodiment of the present invention, a website can provide a central location for assisting with the distribution of information regarding vehicle
20 operations wherein the website includes integrated informational screens displaying vehicle log files and vehicle track plots corresponding to individual vehicle route numbers and dates. Passengers and vehicle operators can access information included on the website to conveniently monitor vehicle activities. In addition, the website can also allow bus operators to provide passengers with estimated delay times for bus
25 routes. The website is then linked to a toll-free number so users can easily access the information. This website function is particularly important when a receiver fails to go off in the expected time period for a bus pickup whereby the parents can call the toll-free number or access the website to investigate the delay.

30 A preferred embodiment of the invention involves the advanced notification of children and their parents of a school bus arriving at a bus stop. Bus operators commonly receive parental complaints regarding excessive bus speed. Previously, there was no means to routinely monitor bus speed to confirm or deny accusations of school buses being operated at excessive speed. With the use of accessible archived

bus log files and bus track plots, bus operators, school administration staff or parents can readily monitor bus speed and travel patterns.

While such a preferred embodiment of the present invention involves the
5 advanced notification of school bus arrival at a bus stop, this notification system has many other applications that include, but are not limited to the following examples. Notifying hospitals of an approaching ambulance carrying severe trauma patients that require immediate attention thereby minimizing inactive waiting periods in an ER. Emergency rescue situations wherein a disabled vehicle or individual activates a
10 transmitter to assist search efforts by rescue parties. Parents can generate a car track plot of where a car equipped with a transmitter has been and at what speeds it was monitor the driving habits of their children. Rental car companies can equip their cars with transmitters to facilitate locating rental cars in parking lots and to provide advanced notification of a rental car return.

15

Other applications for this invention include any situation where point-to-point proximity information would be useful. By delivering proximity information in a cost effective manner by eliminating systems and infrastructure costs, many personal tracking application can be easily contemplated. Thus, these applications are in no
20 way limited to mobile vehicles.

The features and principles of the present invention have been described relative a preferred embodiment thereof. It will be apparent to those skilled in the art
25 that numerous variations or modifications may be made to the preferred embodiment without departing from the spirit of the present invention. Thus such variations and modifications are intended to be included herein within the scope of the present invention.

What is claimed is:

1. A notification system comprising:
a transmission apparatus comprising a GPS device,
a receiving unit that listens for transmitted information to determine point-to-
5 point proximity information for the transmission apparatus and the receiving unit.
2. A system as in claim 1 wherein the system further comprises:
a vehicle,
a vehicle transmission apparatus on the vehicle such that the vehicle
10 transmission apparatus determines the vehicle location by GPS and broadcasts a radio
frequency signal comprising vehicle identification information and vehicle location as
determined by GPS;
the transmission apparatus comprising a central processing unit (CPU), a
transmission module, a GPS device, a memory means and at least one antenna
15 whereby the GPS device calculates the vehicle location using a plurality of global
positioning satellite signals, the CPU generates a signal comprising vehicle
identification information and vehicle location and the transmission module emits a
radio frequency signal comprising the CPU generated signal;
a receiving unit for notifying passengers that a specified vehicle is
20 approaching comprising a receiver module, a CPU, a memory means, and an alert
mechanism wherein said receiving unit receives a RF signal transmitted from a
vehicle transmission apparatus, identifies the RF signal for the specified vehicle,
calculates the distance between the receiving unit and the specified vehicle with GPS
determined locations and activates an alert mechanism if the calculated distance is
25 less than the threshold distance.
3. A system as in claim 1 wherein the system further comprises:
a vehicle
a vehicle transmission apparatus on the vehicle such that the vehicle
30 transmission apparatus determines the vehicle location by GPS and broadcasts a radio
frequency signal comprising vehicle identification information and a vehicle log file
or a portion thereof with at least one time entry wherein each time entry comprises a
time mark and vehicle location;

the transmission apparatus comprising a central processing unit (CPU), a transmission module, a GPS device, a memory means, a vehicle log file stored in the memory means and at least one antenna whereby the GPS device calculates the vehicle location using a plurality of global positioning satellite signals, the CPU enters a new
5 time entry in the vehicle log file stored in memory means, generates a signal comprising vehicle identification information and the vehicle log file or a portion thereof and the transmission module emits a radio frequency signal comprising the CPU generated signal;

a receiving unit for notifying passengers that a specified vehicle is
10 approaching comprising a receiver module, a CPU, a memory means, a historical log file stored in the memory means and an alert mechanism wherein said receiving unit receives a RF signal transmitted from a vehicle transmission apparatus, identifies the RF signal for the specified vehicle, determines the vehicle arrival time by comparing the current vehicle position in the transmitted vehicle log file with the historical log
15 file and activates the alert mechanism when the calculated time to vehicle arrival is less than a threshold time.

4. A system as in either claim 2 or 3 wherein the transmission apparatus broadcasts a RF signal using Spread Spectrum channel hopping technology and
20 receiving units receive Spread Spectrum RF signals from the transmission apparatus by intelligently channel hopping.

5. A system as in any of claims 2-4 wherein the vehicle is a school bus.

25 6. A system as in claim 2 wherein said vehicle transmission apparatus GPS device further determines the direction of vehicle travel whereby the signal generated by the transmission apparatus CPU and broadcast by the vehicle transmission apparatus transmission module further comprises the direction of vehicle travel whereby said receiving unit further compares the transmitted direction of
30 vehicle travel with a stored direction of vehicle travel such that if the transmitted and stored directions of vehicle travel match said receiving unit alerts passengers of vehicle arrival.

7. A system as in claim 3 wherein said vehicle transmission apparatus GPS device further determines the direction of vehicle whereby each entry in the transmitted vehicle log file also includes the direction of vehicle travel such that the receiving unit compares the vehicle location and direction travel with the stored
5 historical log file to calculate the time to vehicle arrival whereby the alert mechanism is activated when the calculated arrival time is less than a threshold time.

8. A system as in any of claims 2-7 wherein the system further comprises the vehicle transmission apparatus which further comprises an interface for
10 connecting a transmitter pendant and a transmitter pendant whereby a vehicle transmission apparatus is programmed by input entered in the transmitter pendant;
the transmitter pendant comprises an interface to transfer information with a bus transmission apparatus, at least one display and at least one input device to change vehicle identification information stored in the transmission apparatus
15 memory means.

9. A system as in any of claims 2-8 wherein the system comprises a transmission apparatus which further comprises a GPS device that further determines vehicle speed and a CPU with the means to create a vehicle log file wherein each
20 entry comprises the time and vehicle information including location and speed and the system has the means to transfer the contents of at least one vehicle log file to a PC.

10. A system as in claim 9 wherein the vehicle log file is downloaded to a PC which comprises the means to generate a vehicle track plot from the information
25 included in the downloaded vehicle log file.

11. A system as in claim 10 wherein a website comprising vehicle information is available to passengers to monitor vehicle activities wherein the vehicle information can include any of the following information vehicle log files,
30 vehicle track plots and estimated vehicle delay times for a plurality of vehicles. Such a website could also be linked to a phone line such that bus operators could easily post, and users could easily access, arrival information and delay notifications.

12. A method for programming a receiving unit as described in claim 2 comprising:

activating a receiving unit learn function protocol as the vehicle for which advanced notification is desirable approaches the location for passenger pickup

5. whereby the receiving unit monitors the transmission signal with the greatest amplitude and when signal amplitude is maximized the receiving unit captures the vehicle identification information and vehicle location such that the location is stored in receiving unit memory as the receiving unit location.

10 13. A method for programming a receiving unit as described in claim 6 comprising:

activating a receiving unit learn function protocol as the vehicle for which advanced notification is desirable approaches the location for passenger pickup whereby the receiving unit monitors the transmission signal with the greatest

15 amplitude and when signal amplitude is maximized the receiving unit captures the vehicle identification information, the direction of vehicle travel and vehicle location such that the vehicle location information is stored in receiving unit memory as the receiving unit location.

20 14. A method for programming a receiving unit as described in claim 2 comprising:

activating a learn function protocol as the vehicle for which notification is desired approaches the location for passenger pickup whereby the receiving unit captures the approaching vehicle identification information,

25 deactivating said learn function after the approaching vehicle has stopped whereby said receiving unit stores the last transmitted vehicle location coordinates in memory as the receiver location coordinates.

30 15. A method for programming a receiver as described in claim 3 comprising:

activating a receiving unit learn function protocol as the vehicle for which advanced notification is desirable approaches the location for passenger pickup whereby the receiving unit monitors the transmission signal with the greatest amplitude and when signal amplitude is maximized the receiving unit captures the

vehicle identification information and vehicle log file or some portion thereof such that the captured vehicle log file is stored in receiving unit memory means as the historical log file.

5 16. A method for programming a receiving unit as described in claim 3 comprising:

 activating a learn function protocol as the vehicle for which notification is desired approaches the location for passenger pickup whereby the receiver captures the approaching vehicle identification information,

10 deactivating said learn function after the approaching vehicle has stopped whereby the receiving unit stores the last transmitted vehicle log file or some portion thereof such that the captured vehicle log file is stored in receiving unit memory means as the historical log file.

15 17. A method of calculating the time to vehicle arrival at a specified point along the vehicle route wherein the method comprises:

 receiving a vehicle location from the vehicle,

 matching the received location to the location parameter of a log file entry in a stored log file,

20 calculating the time to arrival wherein the time in the matching log file entry is subtracted from the time corresponding to the vehicle arriving at the specified point on the vehicle route,

 comparing the calculated time to a threshold time value, and

 alerting a user if the calculated time is less than the threshold value.

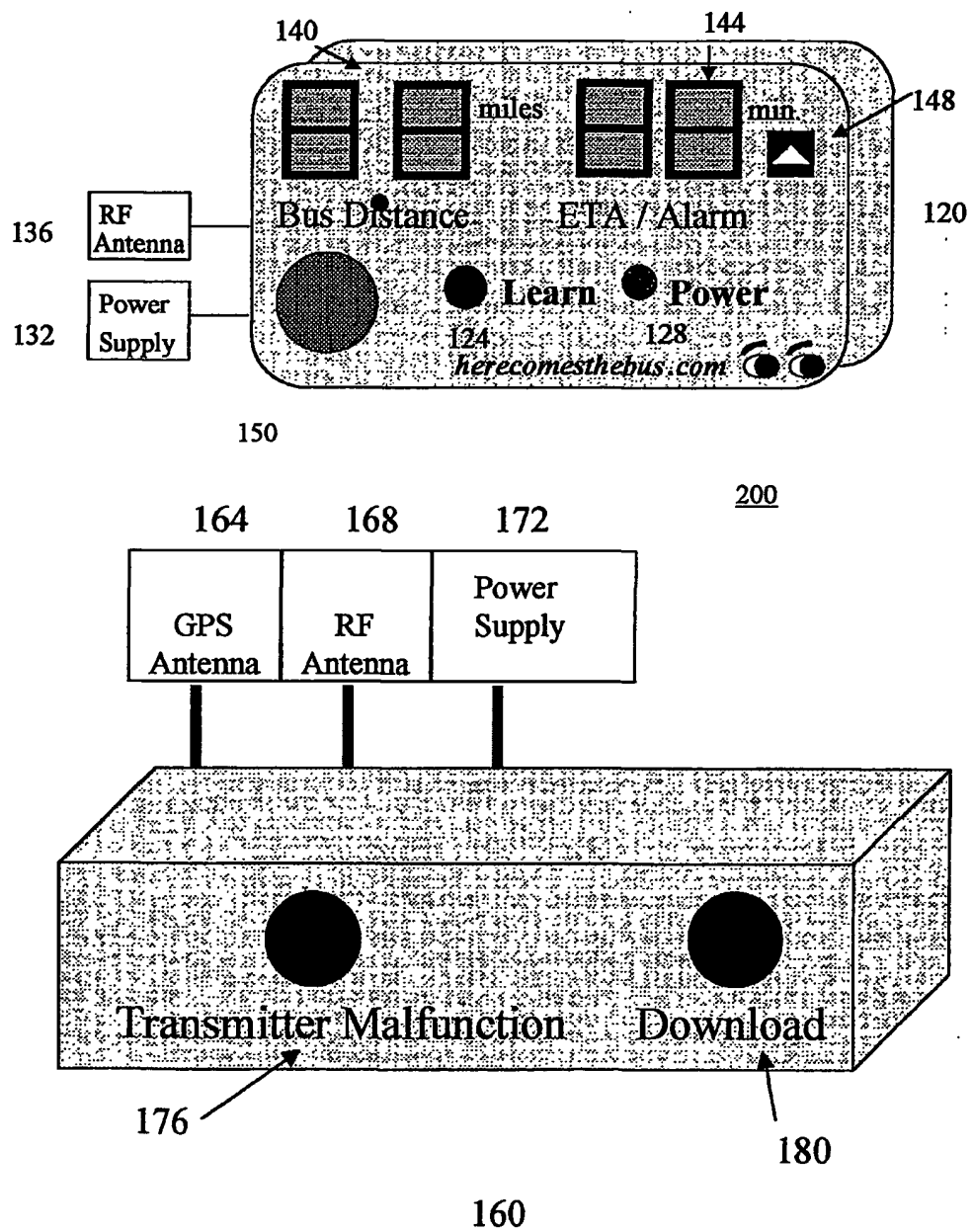
25

 18. A method as in claim 17 wherein the method further comprises matching the received vehicle location and direction of vehicle travel to the location and direction of travel parameters of a log file entry in a stored log file before calculating the time to vehicle arrival.

30

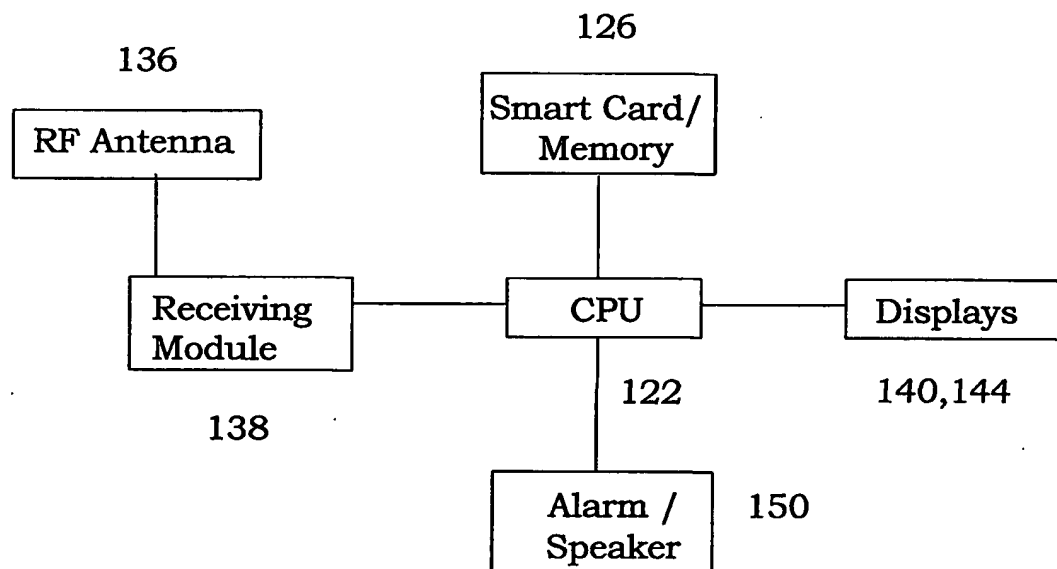
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FIG. 1



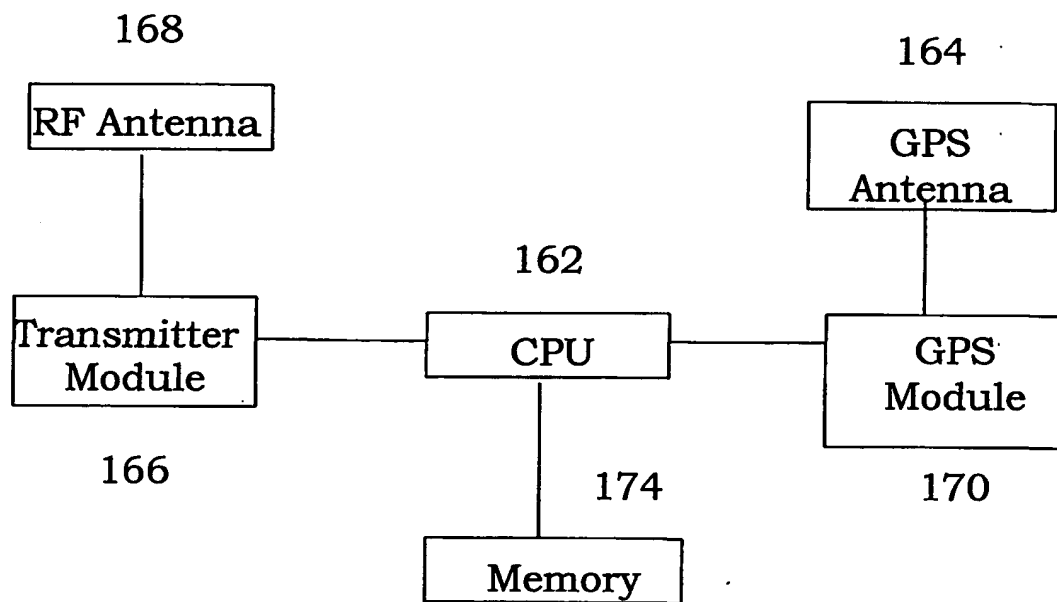
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FIG. 2



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FIG. 3



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FIG. 4

Stored Receiver Log File

Time	Latitude	Longitude	Direction
7:32:00	Lat. 1	Long. 1	Direc. 1
7:32:15	Lat. 2	Long. 2	Direc. 2
7:32:30	Lat. 3	Long. 3	Direc. 3
7:32:45	Lat. 4	Long. 4	Direc. 4
7:33:00	Lat. 5	Long. 5	Direc. 5
7:33:15	Lat. 6	Long. 6	Direc. 6
7:33:30	Lat. 7	Long. 7	Direc. 7
7:33:45	Lat. 8	Long. 8	Direc. 8
7:34:00	Lat. 9	Long. 9	Direc. 9
7:34:15	Lat. 10	Long. 10	Direc. 10
7:34:30	Lat. 11	Long. 11	Direc. 11
7:34:45	Lat. 12	Long. 12	Direc. 12
7:35:00	Lat. 13	Long. 13	Direc. 13
7:35:15	Lat. 14	Long. 14	Direc. 14
7:35:30	Lat. 15	Long. 15	Direc. 15
7:35:45	Lat. 16	Long. 16	Direc. 16
7:36:00	Lat. 17	Long. 17	Direc. 17
7:36:15	Lat. 18	Long. 18	Direc. 18
7:36:30	Lat. 19	Long. 19	Direc. 19
7:36:45	Lat. 20	Long. 20	Direc. 20
7:37:00	Lat. 21	Long. 21	Direc. 21
7:37:15	Lat. 22	Long. 22	Direc. 22
7:37:30	Lat. 23	Long. 23	Direc. 23
7:37:45	Lat. 24	Long. 24	Direc. 24
7:38:00	Lat. 25	Long. 25	Direc. 25
7:38:15	Lat. 26	Long. 26	Direc. 26
7:38:30	Lat. 27	Long. 27	Direc. 27
7:38:45	Lat. 28	Long. 28	Direc. 28
7:39:00	Lat. 29	Long. 29	Direc. 29
7:39:15	Lat. 30	Long. 30	Direc. 30
7:39:30	Lat. 31	Long. 31	Direc. 31
7:39:45	Lat. 32	Long. 32	Direc. 32
7:40:00	Lat. 33	Long. 33	Direc. 33
7:40:15	Lat. 34	Long. 34	Direc. 34
7:40:30	Lat. 35	Long. 35	Direc. 35
7:40:45	Lat. 36	Long. 36	Direc. 36
7:41:00	Lat. 37	Long. 37	Direc. 37
7:41:15	Lat. 38	Long. 38	Direc. 38
7:41:30	Lat. 39	Long. 39	Direc. 39
7:41:45	Lat. 40	Long. 40	Direc. 40
7:42:00	Lat. 41	Long. 41	Direc. 41
7:42:15	Lat. 42	Long. 42	Direc. 42
7:42:30	Lat. 43	Long. 43	Direc. 43
7:42:45	Lat. 44	Long. 44	Direc. 44
7:43:00	Lat. 45	Long. 45	Direc. 45
7:43:15	Lat. 46	Long. 46	Direc. 46
7:43:30	Lat. 47	Long. 47	Direc. 47
7:43:45	Lat. 48	Long. 48	Direc. 48

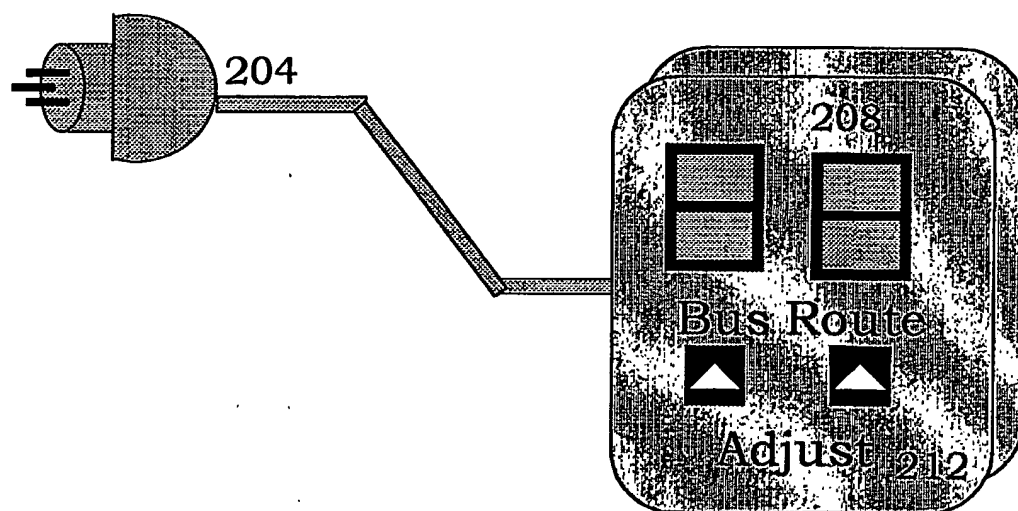
User sets advance time warning to be 10 minutes.
 Receiver look backs 10 minutes in its log file.
 When bus location = Lat. 5, Long. 5, Direc. 5, alarm activates.

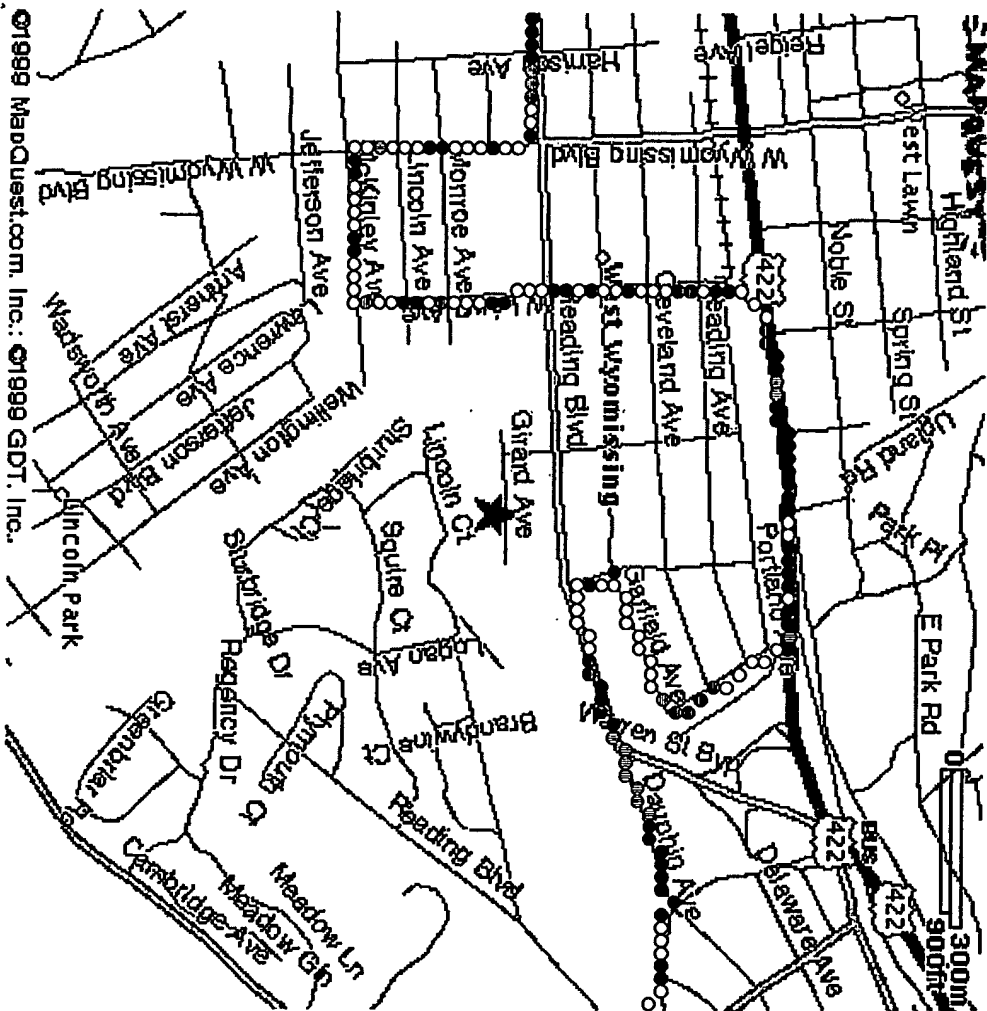
** Learn function activated **

** Signal strength maximized – store this as actual bus stop **

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FIG. 5





Bus Track

FIG. 6

Bus Route: 25

Date: 9/23/00

